

Education and Public Engagement

"Do It Yourself" booklet

iGEM Technion 2016

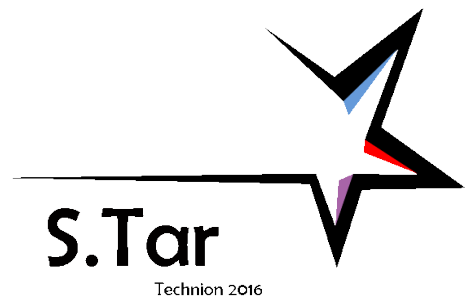


Table of content

Kindergartens	3
Part I: Water in our body	3
Part II: State of matter- water as a fluid	5
Part III: Saving water and the consequences of drought	6
High School students.....	7
College students	9
The general public	10
Seniors.....	11

Kindergartens

Target age: 3-6 years old

Duration: 45 minutes for each part

Main Goal:

Introducing children to the basic terms and tools used in science, while focusing on water - the most important element of life.

The activity is divided to 3 parts:

1. Water in the human body.
2. State of matter: water as a fluid.
3. Saving water and the consequences of drought.

Part I: Water in our body

Goal:

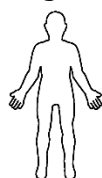
The children will learn that the human body is composed mostly from water, and learn the importance of drinking water.

Materials for 12 children:

- 6 empty bottles of ½ liter
- 6 empty bottles of 1½ liter
- disposable cups
- Funnels
- Bristol paper
- Black and blue markers
- Small plastic bag
- Rubber bands

The Activity:

- Start with a short discussion:
 - Where do you encounter water?
 - Our bodies contain water. How much water do you think that the body contains?
- Activity:
 - Ask one child to volunteer to lay down on the Bristol paper.
 - Using the black pen draw his/her silhouette. The final shape should look like-



- Inside the silhouette, with the help of the children, draw lines using the blue pen to mimic the fluids within the human body. By the time you are done most of the silhouette should be colored blue emphasizing that the body is composed mostly of water.
- Explanation: "Water is an essential ingredient for life, especially for human beings. We consume water through drinking and from eating food as well. But do you know how the water gets out of our body? It goes out through the urine, sweat, tears and more. This is why it's important to drink water often so the body's water balance will be maintained. Now let us try and demonstrate how we lose water!"
- Experiment:
 - Each child gets a plastic bag and a rubber band.
 - The plastic bag should be placed around the hand and sealed with the band.
 - Now each kid should move his/her palm rapidly inside the bag (making noise with the bag can help in encourage the children to participate).
 - After a minute, remove the plastic bag and feel that the hand is wet.
- Explanation:

This was an example for water coming out from our body through sweat.
- Discussion:
 - Do you think we need to drink a big amount of water or a small amount?
 - How much water do you drink in one day? Are 10 big bottles good? Is 1 small bottle enough?
- Explanation:

It is very important to drink every day, but adults need to drink more than kids. The recommended amount of water for children in the ages 4-6 is one big bottle (1 ½ liter) a day.
- Experiment:

The research question – if you have to drink one big bottle of water a day, then how many cups/small bottles you need to drink in one day?

 - Children should work in pairs.
 - Each pair will get one big water bottle (1 ½ liter).
 - Some of the pairs will get the small bottles while the other will get the cups. To answer the research question the children should empty the big water bottles to the cups/small bottles provided to them using the funnel to minimize water loss.
 - After the experiment is done the children should be asked: "So how many small bottles / cups do you need to drink in one day?"
- Summary: Water is the source of life. They compose the majority of the human body, this is why it's important to drink a lot of water along the day, especially when it's hot outside.

Part II: State of matter- water as a fluid

Goal:

The children will learn about the three states of matter: solid, fluid, gas. These states will be demonstrated using water, furthermore they will see some special qualities of the different fluids.

Materials for 12 children:

- Ice cubes
- Disposable bowls
- Popsicle sticks
- Tubes with starch
- Water bottles

The Activity:

- Start with short discussion:
 - The ice cubes should be presented to the children followed by the question: do you know what ice is?
 - Did you know that ice is actually water but in a different form?
- Explanation:

"Most of the known materials on earth are in one of the following states: solid, fluid, gas. These are called "the states of the matter". An example for solid material is wood – it's stiff and cannot move. An Example for fluid material is water – it can move. An example of gas material is the air we breathe – its movement is rapid and we are unable to see it. The state of matter of a material can be changed by heating or cooling it. See for example this ice cube that melted while we were talking. Every state has it special characteristics. Today we are going to focus on fluids."
- Experiment:

Research question – fluids special characteristic

 - Children should work in pairs.
 - Each pair will get a bowl, Popsicle sticks, a tube filled with starch and water bottles.
 - Ask the children to add water to tub with the starch and mix.
 - Pour the tube into the bowl.
 - Tell them to insert their hand slowly into the mix. They should do it easily.
 - Now tell them to put their hand fast in the mix, like a hit. They should struggle.

In the end, the mix should be discarded into a trash can and not to a sink.
- Explain: the starch mixed with water is also a liquid but behaves a little bit different. When adding force it acts more as a solid, and without force it acts more as a fluid. This is very similar to a muscle.
- Summary: we mentioned the three state of matter: solid, fluid and gas. The water we are usually talking about are in fluid state.

Part III: Saving water and the consequences of drought

Goal:

To emphasize the importance of water to all living things/organisms and the consequences of water shortage, giving the desert life as an example.

Materials for 12 children:

- Heating plate
- Markers
- Flower shaped papers.
- Big bowls
- A monitor

The Activity:

- Start with a short discussion:
 - Is the amount of water equal all around planet Earth?
 - Using the monitor, present the picture and discuss the difference between the two sides of the picture, the jungle – a water rich environment – and the desert.
 - Engaging the children – ask if anyone has ever visited a desert and what was special about it?
- Explanation: Usually deserts are a hot place that lacks water. The lack of water is caused by the heat, as due to it most of the water evaporates rapidly, leading to a dry environment. The lack of water causes life conditions to be hard.
- Experiment:
 - Turn on the heating plate.
 - Pour a drop of water on the heating plate.
 - Watch closely as it evaporates rapidly.

This experiment demonstrates the effects of heat on water.
- Experiment: Research question – What are the effects of water on the dry environment and on living organisms?
 - Hand out a flower shaped paper for each child.
 - Ask the children to decorate and paint the flowers.
 - Fold the flower leafs in and place them (floating) in a big bowl of water.
 - Watch closely as the leafs open.
- Explanation:
- Water is essential for all living organisms including plant life. As Israel has a warm climate, and water is not abundant, it is crucial to save water.
- Discussion: As we learned about the importance of water for life, how can we save it?
- Activity: Present the following [slides](#) while discussing which kid is wasting water and what is the correct manner that should be followed.
- Summary: Water is an essential ingredient of life. The lack of water leads to harsh environmental conditions that are impossible to survive! It is crucial to conserve water to save planet Earth.

High School students

Target age: High school students with biology background

Duration: 1½ hours

Goal:

An introduction to the world of “synthetic biology” and the iGEM competition. Furthermore, a short lesson on the basics of the microscope and microorganisms.

Materials:

- [Presentation](#)
- Projector
- Speakers
- Board with markers
- Bristol papers
- Markers, pens, pencils and any other painting tool
- Small microscope
- Glass slides with onion cells, yeast and bacteria
- Petri dishes with agar
- Cotton swab
- Petri dishes with bacteria prepared beforehand.

The Activity:

Part I - Theoretical part:

- Start with presenting the presentation.
- Brainstorming:
The students should be asked the following question: “now that you know what synthetic biology is- what would you do with it?”. Their ideas should be written on the whiteboard. In case that help is needed the following ideas could be used:
 - Plastic digestion
 - E-coli paper- using E-coli to make cellulose, which is the raw material of paper
 - Detection- allergens, mines...
 - Biofuels
 - Food manufacturing - Bacterial hamburger
 - Drugs, Nutrients.
 - Water purification
 - Pesticides
 - Cancer cells diagnostic
- In groups of four students, each group should pick a subject from the list and create an advertisement. After a 15-minute work session the ad will be presented to other groups. This can simulate a small part of the iGEM competition.

Part II - Microscope and bacterial basics:

- Size scale:
 - A short explanation and introduction to the microscope.
 - In pairs, examine the different microscope slides with the bare eye and through the microscope.
- Learn about the bacteria around us:
 - A short introduction to the bacterial world with the help of the Petri dishes filled with bacteria.
 - In pairs, each should use the cotton swab to touch different surfaces including body parts then infect a new agar plate.
 - Incubate the plates and expose the results the following day.

College students

Target age: 18+ years old

Duration: 1½ hour

Goal:

Create a place for students and young adults, with different backgrounds, to hear about different scientific advances and talk with cutting edge researcher. The conversation will be in a relaxed environment, with a cold beer in their hands.

The Activity:

Arrange "Science on the Bar" event which include a scientist giving a lecture about his field of study in a bar.

Tips:

- Ask the bar manager to offer special sale in the night of the event
- Publish the event in every social and written media to get more attention.
- At the night of the event hang advertisement in the entrance of the bar so passerby could see and join to the event.

The general public

Target age: all ages

Duration: 10 minutes

Goal:

Let the general public experience synthetic biology with an activity that mimics all the steps in the cloning process we do in the lab. This is a short activity suitable for a stand at a fair.

Materials:

- Twisting balloons (preferably with a pump)
- Ribbons in various colors
- Legend explaining each ribbon's color such as -
- Scissors
- Scotch tape
- [Flyers](#)



The Activity:

Before the event:

- Print many copies of the flyer to give out.
- Cut ribbons in one color and tie the cuts into circular shape. This will be the basic plasmid. Make a lot of copies to save you work at the event itself.
- Cut short fragments from the rest of the colorful ribbons. This will be the inserts.

At the event:

- Invite people to your stand. Start with showing them the flyer and explain a little bit about synthetic biology. Guide them to do the activity:
 - Take one ribbon plasmid
 - Restriction- Use the scissors (restriction enzyme) and cut out the tie of the plasmid. You should get a linear opened vector.
 - Ligation- Take an insert (short fragment of another color ribbon) with your desired character and with the scotch tape paste the insert into the vector to get a closed circular plasmid again.
 - Transformation- insert your cloned plasmid into twisting balloon.
Note: This is the tricky step, choose your ribbons so they can fit into the balloon.
 - Let the bacteria grow - blow up the balloon with the pump and make any shape you want. We recommend to do a crown with a tail, while the plasmid is in the tail.
- After they successfully cloned their bacteria tell them more about iGEM and about your project.

Tip: you can show this [video](#) to explain the activity better.

Seniors

Target age: seniors

Duration: 30 minutes

Goal:

Expose elders to basic concepts in biology while introducing iGEM competition and our project.

Create a place for seniors and students to interact.

The Activity:

Present the [presentation](#) and add questions time in the end.

Tip: while presenting, try to add as many simple examples as you can as the field of synthetic biology is very complex. A good example is to compare the genetic code to a car manual, gene to one chapter in this manual and protein to the actual component built with the instruction in the manual.